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THE BOTANICAL GAZETTE

EDITORS:

JOHN M. COULTER, University of Indiana, Bloomington, Ind.
CHARLES R. BARNES, University of Wisconsin, Madison, Wis.
J. C. ARTHUR, Purdue University, Lafayette, Ind.

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In the May number will appear:

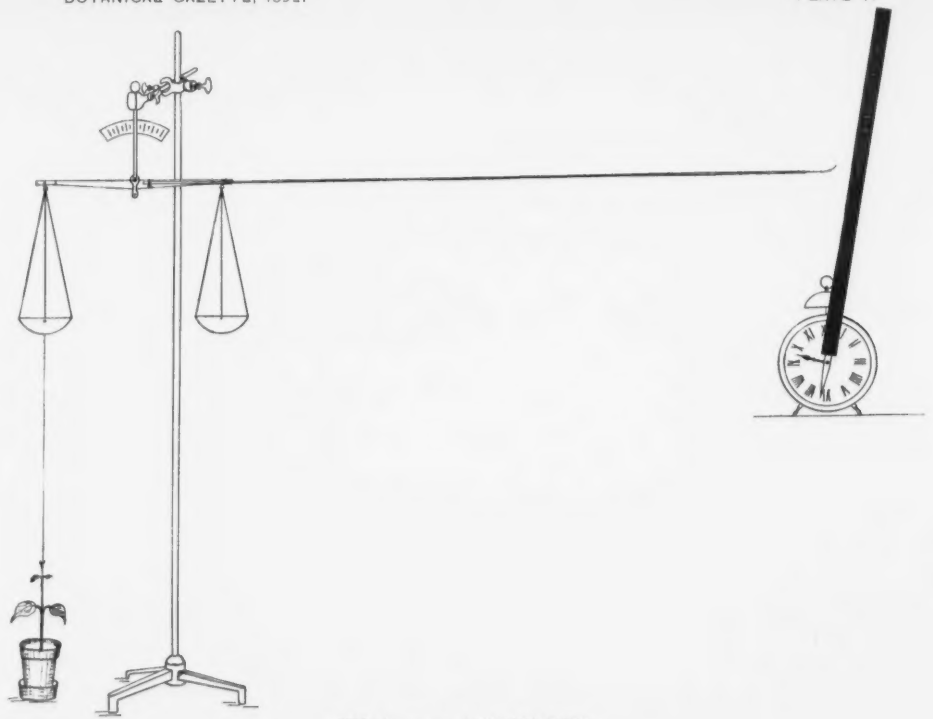
Sereno Watson: a biographical sketch, by PRESIDENT JOHN M. COULTER, *Indiana University, Bloomington.*

Notes on Carex. XVI, by PROF. L. H. BAILEY, *Cornell University, Ithaca, N. Y.*

On the archegonium and apical growth of the stem of Tsuga Canadensis and Pinus sylvestris, by DAVID M. MOTTIER, *Indiana University, Bloomington.*

An automatic device for rolling culture tubes of nutrient agar-agar, by DR. GEORGE F. ATKINSON, *Alabama Polytechnic Institute, Auburn.*

Germination of the teleutospores of Ravenelia cassiæcola, by B. M. DUGGAR, *Alabama Polytechnic Institute, Auburn.*



STONE on an AUXANOMETER.

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BOTANICAL GAZETTE

APRIL, 1892.

A simple self-registering auxanometer.

GEO. E. STONE.

(WITH PLATE V.)

The various forms of self-registering auxanometers used in botanical laboratories are more or less complicated and costly instruments. Such instruments as are used by Sachs, Wiesner, Baranetzky, Pfeffer, and others, vary considerably in their construction and utility. One of the best auxanometers for general purposes that has been devised is that of Baranetzky. A modified form of this apparatus is used by Pfeffer, a figure and description of which is given in his Pflanzenphysiologie.[1]

The multiplying apparatus, which, however, is the most important part of an auxanometer, consists of two grooved wheels of different radii that are fixed to a horizontal axis which revolves on delicate bearings. The large wheel has a radius of 100 mm., and the small one of usually about 12.5 mm., thus giving an enlargement of eight times; over the small wheel there passes a thread, one end of which is connected with the plant, the other to a weight of sufficient size to cause the wheel to respond freely to the movements of the plant. Each movement of the small wheel is communicated to the large wheel which supports the pen and a compensating weight. This apparatus can be used with any form of a registering cylinder; perhaps the most convenient for general purposes is the electric drum that registers in steps.

The accompanying figure shows a simple and inexpensive auxanometer used by the writer, which can be easily constructed by any one. The enlarging apparatus consists of a hand balance, such as is used in every laboratory. The arrangement is as follows: To one of the balance arms there is attached a very light though rigid straw, to the free end of the straw there is fastened, by means of sealing wax, a fine pin of spring brass

[1] See also Goodale's Physiological Botany, p. 383.

wire that serves as a pen. The end of the wire or pen is hammered out very thin, and cut with a pair of scissors to a delicate point. A length of one or two cm. near the base is also flattened to lessen the rigidity of the wire, that the point may offer much less resistance when in contact with the cylinder. It is necessary that the pen should be long and sufficiently curved, so that the straw itself does not come in contact with the cylinder.

To the other balance arm the plant is connected by means of a thread fastened to the under side of the scale. Before attaching the plant, however, enough weight is added to the left hand scale to balance the weight of the straw, after which a small weight (in our experiments .04 gm.) is added to the right hand scale to produce the proper deflection, which should be equal to at least one-half the length of the registering cylinder. The amount of deflection can be determined by a paper protractor fastened at the top of the balance. If now we have a deflection equal to one-half the length of the registering cylinder, and the balance arm be placed at a corresponding point above the horizontal position, the pen will have an amplitude of motion equal to the whole length of the cylinder. When the balance arm is in this latter position the plant is attached, and it is evident now that the tension on the thread would not be .04 gm., but .08 gm. It is desirable that the straw and pen should be exceedingly light, so as to interfere as little as possible with the sensitiveness of the balance.

Such an adaptation of the hand balance answers as a simple substitute for the more expensive multiplying appliances; moreover it possesses a greater degree of sensitiveness, although, as we have seen, the tension is not constant. For example, it may be .08 gm. in the beginning of the experiment, and only .04 gm. when the balance arm is in the horizontal position, but this variation we believe is practically unimportant with such small weights. The original apparatus of Sachs required a weight or tension of 20 gm.; that of Wiesner of 7 to 10 gm.; and the apparatus used by Pfeffer, even when compensated as fine as possible, must have a tension of 1.5 gm.; in general, however, this apparatus is used with a tension of 3 to 10 gm.

It is a well known fact that even a tension of a few grams affects the normal growth of a plant; notwithstanding this

fact, the relative growth curve produced by a large tension is correct, provided the first hourly registrations be neglected.

The registering apparatus consists of a cheap nickel clock costing seventy five cents. The minute hand is removed from its spindle and a piece of thin metal carrying the cylinder is put on instead; one end of this piece of metal is pointed and of sufficient length to answer as a substitute for the minute hand; the other end supports the cylinder and is bent outwardly, for the purpose of having the latter stand out some distance from the dial. At its point of attachment to the minute hand spindle it is considerably thickened, and the hole is made of sufficient size to allow the piece of metal to be driven on firmly. The cylinder consists of one turn of ordinary glazed paper, blackened on one side over a lamp, and having a length of about 36 cm. and a diameter of 2 cm.; it is fastened to the metal by means of soft wax. The cylinder makes a revolution once every hour, and by so doing the growth of the plant is registered by a series of parallel lines. For its successful revolution it is important that all the parts should be exceedingly light. The clock used by us was not in the least affected by the weight of the cylinder, and was capable of running 30 hours without re-winding. If, however, the cylinder is very large there is a possibility of the spindle slipping on its axis, which would prevent it from revolving. In case this should happen, or it should be desired to use even a larger cylinder, the difficulty is easily remedied by attaching a projecting rod supplied with an adjustable compensating weight to the other end of the piece of metal, so that its centre of gravity can be made to coincide with the axis of rotation; by careful compensation a weight of considerable size can be made to revolve successfully.

In a permanent apparatus a clamp provided with clips to fasten the cylinder and for the easy removing of the same from the spindle could be advantageously substituted for the piece of metal described above. If one wishes to obtain a continuous curve of growth the clock can be placed horizontally and a disk of metal be constructed so as to slip over the hour hand arbor. A cylinder of metal, wood, or even a glass-jar, covered with smoked glazed paper, or millimeter-ruled paper, can be placed upon the disk to record the growth. With millimeter-ruled paper it is necessary, of course, to substitute an ink pen for the metal one.

Suggestions on the classification of Metaphyta.

CONWAY MACMILLAN.

The sciences of botany and zoölogy are not yet sufficiently advanced, it may be, for the proposal of that system of classification which, at once comprehensive and natural, shall bind together all our ontogenetic and phylogenetic discoveries and generalizations into a harmonious and enduring structure. The season of patient toil in the acquisition of new facts in the departments of comparative morphology and embryology is not yet past; and to both the zoölogist and the botanist there is still a vast terra-incognita presenting its untried paths for the work of discovery and cartography. To indicate what seems to be a possibly fruitful line of investigation — or rather to suggest the continued investigation of an already indicated and partially explored region, from a somewhat different point of view than the ordinary one — is the object of this paper.

The bald statement that there exists a great group of living creatures with which students of biology have long been familiar, but of which there is as yet no classification, no Systema, no Tournefort or Linnaeus, and no compendium or monograph of any sort, borders closely on the sensational. From a certain point of view this is, however, a fair statement and one that can be defended. The groups to which reference is made have been studied since the time of Camerarius and properly understood since the days of Hofmeister. Their presence as organisms is nevertheless owing to the persistence of ancient habits of thought, largely overlooked by the students of to-day. The accepted classification of the plant kingdom into Protophyta and Metaphyta buries every vestige of the group, and it is only by modifying that classification that the lost tribes may be made to emerge from their obscurity. In the briefest manner let us examine the ascertained facts of progress which are considered of importance in determining the rank of successive series of plants and animals. First and lowest in the scale of differentiation are those organisms which can not be safely grouped either with the plants or with the animals. These are the Protista of Hæckel, the third kingdom. From them as a substratum the two phyla of plants and animals arise. In each branch of the primitive trunk the lower series of organisms are devoid of sex, purely vegetative even in their reproductive functions. These are

the Protophyta and the Protozoa, or if one should apply names to indicate the physiological character upon which the groups are founded, the Agamophyta or sexless plants, and the Agamozoa or sexless animals. With such transitional forms as Ulothrix and some of the ciliated Infusoria the two higher groups of organisms are introduced and we may distinguish the sexual plants, Gamophyta, from the sexual animals, Gamozoa. This latter branch is almost equivalent to the Metazoa, but the Gamophyta as here limited constitute but a small portion of the organisms which are included as Metaphyta. It is precisely here that the great hiatus between our classification of plants and animals is to be discerned. To appreciate properly the true condition of things is perhaps more easy if we divide the Metazoa and Metaphyta, respectively, into two co-ordinate groups. This is a division of organisms, not of species, and can be performed, I think, without violence to right thinking. There may be distinguished, then, in the plant phylum the Sporophyta and the Gamophyta, and in the animal phylum the Sporozoa and Gamozoa. A sporophytic or sporozoic organism might be defined briefly as one that develops primarily from a segmentation-cell (fertilized egg, parthenogetic egg or vegetatively apogamous cell) and normally forms in turn perfect reproductive cells or *spores*. In the plant phylum this group includes a most diverse and numerous series of organisms, from the four-zoospore-plant of Œdogonium to the moss-capsule, the ferns, club-mosses, pines, cycads, and all the herbs, shrubs and trees with which we are familiar. In the animal phylum, however, the Sporozoa would include only a very few and relatively insignificant organisms, chiefly among the Cœlenterata, and doubtfully extending among the Tunicata; that depending upon whether the views of Brooks or of his critics are to be accepted concerning the homologies of the salpa-chain.

With the division of the two branches, Metaphyta and Metazoa, it becomes apparent why the coördination of plants and animals under any of the systems is so unproductive of the most valuable systematic or philosophical results. We do not compare, habitually, the Sporophyta with the Sporozoa, but with the Gamozoa, thus missing the chance of determining the true parallelisms and homologies, if any exist. That sporophytic structures may not be compared (except physiologically) with gamophytic has already been shown by

Bower,[1] but it does not seem to be out of place to insist here that such structures and organisms are even less aptly compared with the Gamozoa.

It will be recognized as of high importance to discriminate in the two divergent phyla of plants and animals the truly double and parallel composition of each of the upper series. And, since the structural development in the two phyla varies reciprocally, it is not possible to compare them without clearly perceiving the double nature of each. For in the Metaphyta the sexual series has undergone progressive structural degeneration from the mosses to the highest of the Siphonogama, while in the Metazoa the sexual series manifests increasing complexity from the lowest Cœlenterata to the Primates. On the other hand, in the plant phylum, sporophytic organisms from the Œdogoniæ to the highest Metachlamydeæ show a constantly increasing structural differentiation; but in the animal phylum, sporozoan organisms are developed only low down in the scale and are discontinued long before the higher classes are reached. I have already indicated elsewhere what may be the reason for this remarkable difference between the two kingdoms[2], and it will suffice to suggest that the relatively great immobility of gamete-producing, that is sexual, plants is the primary cause of their defeat in the struggle for food, sunlight and organization with the more capable sporophytes. This supremacy of the sporophytes is so complete that all the higher gamophytic plants have been forced into a most abject condition of parasitism upon the sporophytic structures of their own species.

The great mass of the species grouped in the Metaphyta are, therefore, persistently and strongly dimorphic, and it is this dimorphism which distinguishes the plant from the animal phylum. The essential diagnostic character of the Metaphyta might be described, indeed, as sharply defined specific dimorphism. While the higher animals may, for each species, be separated into two groups of organisms differing only in sex, the higher plants may, for each species, be divided into perhaps four groups or organisms, viz., the pollen-bearing, the pistil-bearing, the male (pollen-tube) and the female (embryo-sac contents). This conception of the plant

[1] Bower: Antithetic and Homologous Alternation; Ann. of Bot. IV, 347–370, 1890.

[2] MacMillan: Amer. Nat. XXV, 22—25, 1891.

species is of course rendered difficult by the as yet uneradicated error of considering pollen-tube and embryo-sac contents in the light of organs belonging to the sporophytic forms of the species. I have had occasion before, in these pages,[3] to call attention to the wellnigh hopeless confusion of botanical terminology in this region of the science. When Goebel speaks of the fertilized macrospore of Pilularia being attached to the ground by its prothallial rhizoids[4], or when Müller entitles a work "The Fertilization of Flowers," in which *fertilization* is not even mentioned, it serves to illustrate how deeply rooted is the fault of nomenclature which perpetuates the ancient errors of Camerarius, Linnæus, Sprengel and Erasmus Darwin.

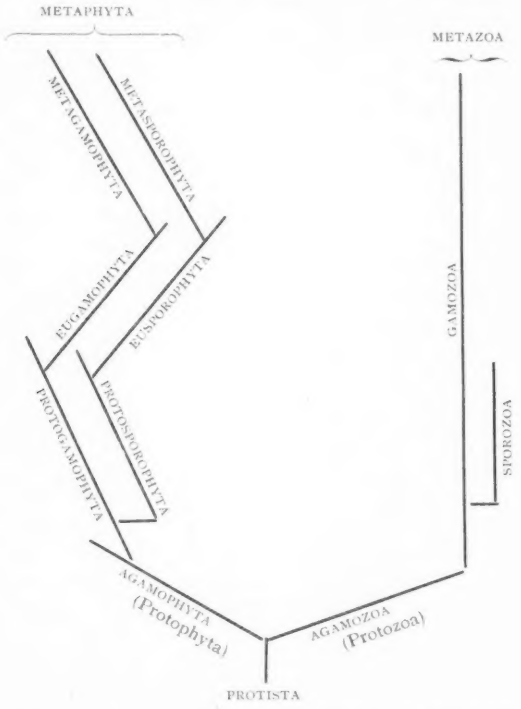
It is clear that there must still be much study before botanists can hope to define their species correctly, to say nothing of grouping them in an enlightened manner. The emancipated zoölogists of the day are accustomed, with an air not unfamiliar, to deprecate the attention bestowed upon classification and systematic work by the botanists. They do not, perhaps, discern that in a way the problems of the botanist are two-fold as complex as their own, just as the organisms with which the botanist has to do are doubly complicated. Up to this time so little material has been examined that there are very few species of Gamophyta accurately described. It is inconceivable that there should not exist differences between the male plants of Salix and Populus, for example, in some way related to the differences between the sporophytes. What these differences are is a task for future investigation. It may be many years before the *Genera Plantarum* or the *Histoire des Plantes* of the higher Gamophyta is written; but such a work is imperative before it can be pretended that we are in a position to fitly describe or classify the plant phylum in a final manner.

The evolution of sporophytic structures in the plant kingdom is so considerable that certain divisions should be noted in their development if they are to be set off against the far less important and less highly evolved group of the Sporozoa. Otherwise a wrong impression will be given in the comparison. With this in view it may be advisable to recognize in

[3] Bot. Gazette, xvi, 178, 1891.

[4] Goebel: Outlines of Classification and Special Morphology, Eng. tran., 243.

both the Sporophyta and the Gamophyta three fairly well-marked physiological divisions: first, the lowest Sporophyta are included in the gametophytic body and are therefore parasitic upon the sexual plant, e. g., Œdogonium, Chara, Riccia. Second, the higher forms are self-supporting and do not nurse the gametophytes, e. g., the higher mosses, the lower fernworts and club-mosses. Third, the highest forms act as host-plants for dependent, symbiotic gametophytes and



are so specialized, e. g., the seed-plants and the higher fernworts and club-mosses. These groups might be named respectively the Protosporophyta, Eusporophyta, and Metasporophyta, in order to facilitate reference without paraphrasing. Similarly, the lowest Gamophyta do not furnish nutriment for sporophytic structures of their own species, e. g., Ulo-

thrix, Fucus, Peronospora. The higher support dependent sporophytes, e. g., Œdogonium, Marchantia, Sphagnum. The highest are symbiotically parasitic upon sporophytic structures of their own species, e. g., the Isoetineæ, Selaginelleæ and Siphonogama. These might be named respectively the Protogamophyta, Eugamophyta, and Metagamophyta. It is this last division that constitutes the principal part of the unexplored region. The accompanying diagram indicates the grouping of living things here suggested.

University of Minnesota, Minneapolis.

Some fungi common to wild and cultivated plants.

BYRON D. HALSTED.

Reference is here made to the relation of the fungous parasites of wild plants, including weeds, to our crops whether of fruit, grains, or vegetables. This deleterious influence can best be brought out by taking up some of the worst fungous enemies to crops and showing the range of these parasites upon the surrounding wild plants.

Starting with the garden vegetables it is easy to find illustrations on every hand. Thus the lettuce mildew, *Bremia Lactucæ* Reg. is found up to date upon no less than forty-one species of plants belonging to the same family as lettuce and closely related to it. Many of these hosts for the mildew are common garden weeds and others inhabit the uncultivated ground.

The celery rust, *Cercospora Apii* Fr. now so destructive with truckers, is common to the carrot and parsnip also, and as the wild form of these abound without stint in many localities we need not wonder that the garden plants are partially destroyed by this pest.

There is a mildew of the spinach, *Peronospora effusa* Gr. that flourishes upon the pigweeds generally, there being no less than ten of these weeds that are thus infested and furnish a propagating place for the mildew of their patrician cousin grown on a salad plant.

The bean rust, *Uromyces appendiculatus* (P.) is one among a conspicuously destructive group of fungi that makes its home upon several species of wild beans.

But of wider range than any species yet mentioned is the mildew of the pea, *Erysiphe Martii* Lev. which renders it almost impossible to grow late peas. This fungus preys upon plants of at least six large and quite widely separated families and therefore in any neighborhood may have ample means at hand for keeping up its abundant stock of specimens.

The mildew of the cabbage and turnip, *Peronospora parasitica* (P.) is not an unmixed evil however, for because of its wide range it attacks the shepherd's purse, various mustards, and a number of other weeds. The hosts enumerated in a list recently consulted were thirty-five, and most of these are common plants in all parts of our country. Another fungous disease of the cabbageand turnip, namely, the club root, *Plasmodiophora Brassicæ* W. while as yet not recorded outside of these two hosts and the radish, very likely is at home with many of the other plants of the same order, but root diseases being out of sight are not easily found unless specially looked for.

Coming to the fruits and beginning with the lowest in stature, the cranberry, we see a fine instance of the question in hand in the gall fungus, *Synchytrium Vaccinii* Th. The following, mostly small shrubs growing along the shore or border of the bog, are afflicted with the same disease: azalea, sheep laurel, white alder, leather-leaf, huckleberry, and wintergreen. While these plants are members of the same family, they all differ considerably from each other and from the cranberry. It is evident that any remedy applied to be effective would need to include the infested shore shrubs.

The strawberry blight, *Sphærella Fragariæ* (Tul.) is met with upon wild vines of both our common species.

Sphærotheca Mors-Uvæ (Sch.) producing the gooseberry mildew and crippling an industry in this country, is found upon several species of our wild gooseberries. The writer recalls collecting fruit and young twigs entirely covered with the thick brown felt in the cañons of Colorado, where there were no cultivated bushes perhaps within five hundred miles. In like manner the anthracnose, *Glœosporium Ribis* (Lib.) that causes the premature dropping of foliage, is common to several species of currant.

The blackberry rust, *Cæoma nitens* (Sch.) is an especially important illustration of the relationship of wild plants to those close of kin that are cultivated in the garden. This conspicu-

ous rust grows upon the low blackberry, dwarf raspberry, thimbleberry, wild red raspberry, high blackberry, and sand blackberry. In a trip through the Carolinas in May last, this orange colored fungus was to be seen at nearly all times from the car window and one could but pity the cultivated species of Rubus, were there any grown in that afflicted region.

The diseases of the grape and in particular the mildew, *Plasmopara viticola* (B. & C.) are in general common to all wild species of the vine. The worst specimens I ever found were those of a wild plant in Iowa, many miles from any cultivated vines and the mildew was so bad upon the canes as to dwarf them to a few inches in length while they were covered from one end to the other with the white down of the fungus. Not only the *Vitis æstivalis*, *V. Labrusca*, *V. vinifera*, *V. riparia* and *V. Californica* are infested, but likewise the closely related Virginian creeper and more recently the Boston ivy are victims.

Among the plums and cherries we find four parasitic fungi to interest us in this connection, for they abundantly illustrate the fact of the close relationship of wild with our cultivated plants. First the plum pockets, *Exoascus Pruni* (Fcl.) are familiar to all as peculiar distortions of the fruit and stems of the cultivated plum, dwarf cherry, bird cherry, choke cherry, and some other species of the genus Prunus. The peach curl, *Exoascus deformans* (Berk.) also infests the dwarf almond, common garden plum, and three kinds of cherries, besides the peach. There is a rust, *Puccinia Pruni* Pers. which is very destructive in some parts of the country particularly to the peach and apricot in California. No less than ten species of the genus Prunus are subject to attacks from this enemy and the list includes the peach, apricot, plum and cherry, several of the last two being wild trees or shrubs.

Last but not least for the genus Prunus is the black knot, *Plowrightia morbosa* Sacc. As this enemy is of great magnitude it merits the naming here of the eight species that are subject to attack; namely, the Chickasaw plum, *P. Chicasa* Michx.; the beach plum, *P. maritima* Wang., a thorny shrub on the sandy sea-shore; the wild yellow plum, *P. Americana* Marsh., a shrub or small tree along streams. Of the cherries, the choke cherry, *P. Virginiana* L., a small tree, is most frequently infested; but the wild black cherry, *P. serotina* Ehrh.,

a tree of the hedge rows, and the wild red cherry, *P. Pennsylvanica*, are also attacked.

It is evident from the illustrations that have been given of the diseases of the genus Prunus that there must be a close relation existing between the wild plants and those grown for fruit. What with the plum pockets, the curl, rust, and black-knot, it is evident that more attention needs to be paid to the wild hosts of fungi of cultivated plants before the latter can be free from their attacks of their present enemies.

There is a mildew, *Podosphæra tridactyla* (Wallr.) so widespread that it cannot be assigned to any one crop. Because very destructive upon the apple and particularly seedlings in the nursery it has been called the apple leaf mildew, but in some localities cherries, both old and young, suffer severely from it. It preys upon the quince, several species of the hawthorn, the June berry and various spireas. It seems to be a well established fact that plants that are closely related are quite apt to be subject to the same fungous enemies. But it does not follow that plants not near of kin will not have parasites in common. For example, within the past year it has been fully shown that bitter rot or ripe rot of the apple fruit is the same fungus that causes one of the dreaded decays of grapes. In like manner at the New Jersey experiment station it has been found that one of the worst enemies to the sweet potato is identical with a serious disease of egg plants. There seems little in common between the sweet potato and the egg plant and yet in the face of the fact of a common enemy it may suggest the importance of not following one crop by the other in those localities where they are both grown prominently and one or both are already more or less diseased.

In like manner it has been shown that a bacterial disease of the potato also affects the tomato and *vice versa*; and that was to be expected as both hosts are closely related; but that one disastrous form of melon blight is due to the same cause was unexpected because of the lack of kinship between melons and potatoes. The inference was that if melons were attacked cucumbers and squashes would also be. This was shown to be true and before the season was through it was found that much damage to the cucurbits generally was due to the bacterial disease.

Space forbids even the briefest mention of many other cases where plants wild affect the health of plants cultivated

by being the means of supply of fungus germs. One other instance that illustrates a phase of our subject not before touched upon may be given. The plant is a familiar one to many and painfully so to not a few. This is the apple rust (*Ræstelia*) that yellows the foliage of the orchard in July and shortens the crop at picking time. This fungus plays a double role and seems unable to get along with the apple tree alone. In a second and very different form, *Gymnosporangium*, it infests the cedar trees, there forming knots or galls that become conspicuous as gelatinous balls during the spring rains. These orange colored balls furnish the spores, which falling upon the foliage and fruit of the apple tree, produce the fatal rust. Later in the season the spores from the apple fungus go back, upon the wings of the wind, to the cedar and a new crop of galls is obtained for next spring's campaign against the orchard. In this case it is not wild apple trees or those of the same family that harbor the enemy, but a tree as widely separated botanically from the apple as is well possible. More than this, the fungus changes its form in passing from one to the other so that it was not until demonstrated by actual cultures that the relation, long suspected, could be fully believed. It is needless to say that the very evident method of procedure is to destroy cedar trees that are anywhere near the apple orchard. A single large gall-bearing cedar tree just outside the orchard fence may do more mischief than any enemy that is lurking within the enclosure.

It has been shown by means of a long series of examples that the evil influences of wild plants may act at long range. It is not necessary that their roots and those of the cultivated plants hould cross each other's paths in the soil or that their branches should interlock and overshadow one another in a deadly embrace. There is a more subtle bad influence than gross thieving or clutching by the throat. It is more in the nature of a poison that is sent out upon the air to be breathed in by the innocent wherever they may unwittingly meet the unseen but de ıdly germs.

Crowding of plants is bad, rank growth of weeds is worse, but the most fatal of all influences is that unseen group that steal away the health of the plants which lack nothing for room and enjoy high and thorough culture.

After all it is the host of enemies that swarm from the

plants outside the garden fence that try the patience of the husbandman. He has learned the methods of remedying the others, but the floating spores defy his keenest eyesight to discern and baffle his ingenuity to combat. The ways of the fungi are however being slowly and laboriously revealed by the microscope and conquered by the spraying pump. The former assists the latter, which as yet somewhat blindly fires effective "small shot" into the enemies ranks.

Proper seeding, fertilizing, and weeding will do much to assist, in warding off the deleterious influences of fungous enemies for healthy plants, while not proof against their attacks, are less liable to be overcome by them. Let therefore everything be done that is possible before the last resort comes and then the fungicide will have the greatest effect and yield the most returns. If so much of the smut, rust, mildew, mold, rot, and blight of our cultivated plants is propagated by the wild plants hard by, it may be wise for every crop grower to pay attention to what is thriving outside his garden wall. He cannot build it high enough to shut out the spores, but he can do much to diminish the number of these spores. Having done this, he can take up the spraying pump with a brighter hope of future success. There was a carcass, so to speak, in the pasture and he went out and buried it. Fungi are the basis of contagion and they infect at long range by means of their myriads of invisible spores. To learn of their ways and find better methods of resisting them make the burden of many a station botanist's labor today.

Rutgers College, New Brunswick, N.J.

Noteworthy anatomical and physiological researches.

The stem and leaf of the mosses.[1]

After alluding briefly to the principal works on the subject of his research, the author takes up the study of the anatomy of the aerial stem of mosses, distinguishing four types.

I. With uniform parenchyma containing chlorophyll bounded by: 1. A zone of aquatic cells; 1st type, Sphagnum. 2. An epidermal layer; 2d type, Thuidium.

[1] BASTIT, EUGENE: — Recherches anatomiques et physiologiques sur la tige et la feuille des mousses. Revue général de botanique III (1891.). pp. 255, 306, 341, 373, 406, 462, 561.

II. With parenchyma differentiated into a central cylinder and parenchyma containing chlorophyll. 1. Central cylinder uniform; 3d type, Mnium. 2. Central cylinder differentiated into a medullary region and a surrounding pericyclic zone; 4th type, Polytrichum.

In using the term "pericyclic zone," the author remarks that "as to its development, it is not comparable to the pericycle of the phanerogams, and in general, a strict analogy cannot be established between the tissues of the stem of the mosses, a product of the asexual spore, and the stem of the higher plants, a product of the egg."

From this pericycle and central pith arise the leaf traces, which diverge from the center according to a law constant for each species. The trace reaches its maximum differentiation at the periphery of the stem as it passes into the leaf costa.

In mosses with a central cylinder, branch traces are found arising by differentiation of the medullary tissue and the pericyclic zone. Here, also, the traces follow a law of divergence constant for each species.

For his study of the leaf the author uses *Polytrichum juniperinum*. He regards the chlorophyllose lamellæ as an assimilative tissue and "from analogy, comparable to the palisade cells of phanerogams."

The subterranean stem of Polytrichum juniperinum is worked out with very interesting results. The outline in cross section is bluntly (tri)angular, and instead of the concentric arrangement seen in the aerial stem, the tissues are grouped radially into three sets of structures. In the apex of each angle, adjacent to the epidermis, is a hypoderm bundle, bounded on the inside by the hypoderm sector. This structure, being more extensive at the periphery than the bundle, is adjacent to the epidermis laterally for some distance, and narrows rapidly toward the center forming a rude Y which includes the hypoderm bundle between its forks. In contact with the inner end of the stem of this Y is the crescentic pericyclic sector, placed with its concavity outward and transverse to the stem of the Y. Bounding this sector, along its convex inner surface, is the central pith. Filling the spaces along the sides of the (tri)angular section are the three isolated cortical regions extending from the epidermis to the central pith.

In *Dawsonia superba*, a new Zealand relative of Polytrichum, instead of a single hypoderm bundle, there are generally three arranged radially, increasing in differentiation as they approach the exterior. The origin of the hypoderm bundles is thus plain. Their first elements arise by differentiation of cells of the pericyclic sector, *i. e.*, the bundles are of internal origin. The remaining elements are added from the hypoderm by the differentiation of its cells.

The relation of the peculiar triangular radial symmetry of the subterranean stem to the circular symmetry of the aerial stem is worked out and the transition described. The sectors and bundles of the angles extend laterally until adjacent ends meet and at the same time the radial extension diminishes, thus gradually bringing the radial arrangement into the concentric.

The more important physiological results are here summarized.

When an aerial moss (Polytrichum juniperinum was used) is subjected to an aquatic life, the epidermal layer of the stem and leaf is profoundly modified. The size of the cells is enlarged, the cuticle disappears and the slightly thickened walls retain a cellulose nature. The leaf loses its chlorophyllose lamellæ, the limb is reduced and the form slightly modified.

If the mosses are grown in air or in water, and the conditions of light and the orientation of the stem are varied, the stems are found to be very feebly negatively geotropic, and strongly positively heliotropic. Heliotropism is always predominant, and young shoots always grow toward the light whatever be their position.

Under the influence of humidity of the air, the leaves of certain mosses take two positions upon the stem: one corresponds to the hygrometric state approaching saturation, the position of expansion; the other, to a state approaching dryness, the closed position. In passing from the open to the closed position or *vice versa*, the leaf executes movements in both longitudinal and transverse directions. The movements begin in the leaves at the base of the stem, and extend gradually to those at the summit. The cause of the movements is found in the contraction aud the turgescence of the cellulose membranes of the leaf.

In both the open and the closed condition mosses respire in darkness, evolving CO_2 and absorbing O; the relation be-

tween their volumes remaining constant between 17° C. and 20° C. As regards the respiratory function, then, the mosses come into the general case of chlorophyll-containing plants. In the closed condition, the activity of the chlorophyll function (assimilation) diminishes nearly 50 per cent. The activity of both respiration and chlorophylline assimilation abates as the moss becomes dry. The inference may be made that these functions slacken during the summer with the mosses. It is in spring and autumn, when they are continually moist, that they elaborate nutritive materials most actively. This explains the appearance of the sporogonia during these seasons in so large a number of species. — RODNEY H. TRUE.

Anatomy of the stolons of Gramineæ.[1]

Although the function of the stolons in the Gramineæ is nearly the same, being at once reservoirs of nutritive matters and organs in the service of the vegetative propagation, the author has observed several differences in the interior structure. And he claims at the same time, that the two general types of stolons, which have been proposed by another author, Mr. Johanson,[2] are not sufficient, when the question is to characterize the structure of these organs in general. The two types mentioned by Mr. Johanson were distinguished by the different arrangement of the mechanical tissue, which is either central with a large cortex in contrast to a reduced pith, or nearly subepidermal with a large pith and a reduced cortex. But the author enumerates now several other anatomical features, observed in stolons of different genera, which occur under different conditions. He shows from the numerous intergradations between the stolons under-ground and the shoots above-ground, that the organization of the stolon depends upon a modification of the above-ground shoot. The structure of the shoot above-ground is well marked by the position of the mechanical tissue, which is either truly subepidermal or more or less distinctly subcortical, the bark being as a rule not very strongly developed. But there is a large series of modifications between this form and those derived from such shoots as show a tendency to replace stolons.

[1] P. HELLSTRŒM: Naagra iakttagelser angaaende anatomien hos græsens underjordiska utlöpare. Bihang Kgl. Sv. Vetensk. Akad. Hdlgr. vol. XVI, no. 3, Stockholm, 1891.

[2] Kgl. Sv. Vetensk. Akad. Hdlgr. vol. XXIII, no. 2, p. 30.

There is also given an account of the structure of the scale-like leaves, which cover the stems under-ground. These consist of a strongly mechanical tissue, which encloses the mestome-bundles, which here often contain a mere leptome. This, as it seems, peculiar fact is, however, easily explained, since the function of such leaves is not assimilatory; they do not need, therefore, the elements of the hadrome, but merely the leptome, for the supply of already prepared organic matters. The function of the strongly developed stereome in these leaves is not only to protect the leptome, but also to form a kind of support to the entire stolon.

As regards the endodermis, the author states several variations in the stolons, which he has examined, and which he refers to two groups: the so-called O-endodermis, the cells of which are thickened equally all around, while in the second one, the C-endodermis, it is merely the inner and the radial walls in which a thickening has taken place. A double endodermis was observed in some species of Triticum, Calamagrostis and others. (The writer takes here the opportunity to call attention to similar studies upon our native grasses, in which the vegetative propagation is so strongly predominant, and which might give still more extended illustration of the characters enumerated above.)—THEO. HOLM.

Studies upon germination.[1]

In a recent paper[1], Hildebrand describes the germinating plantlet of *Cecropia peltata* upon which he has observed a long series of different forms of leaves, from ovate to cordate, gradually succeeded by peltately three or five-lobed leaves until finally the typical form appears in the nine-lobed leaf. He shows also the gradual development of the "domatia" at the base of the petioles, in which the protecting ants take up their residence and feed upon a certain kind of exudation. These domatia are not present, however, at the very earliest stage of the plantlet, and the plant is therefore forced to provide another kind of protection against the climbing, leaf-eating ants. This is done by short branches developing from the lower leaves, having merely two sessile stipules, which are bent downwards and thereby prevent the animals from climbing the stem. It is only when about the twentieth leaf is de-

[1] Fr. Hildebrand: Einige Beobachtungen an Keimlingen und Stecklingen. Botan. Zeitung, 1892, Nos. 1, 2 and 3.

veloped that the stem has attained a sufficient thickness to give shelter to the protecting ants and to produce the exudation. The author has also observed a similar fact concerning the protection of ants in *Acacia cornigera*.

Another interesting fact, to which the author calls attention, is the difference in germination of closely related species. It is especially striking in the genus *Anemone*, and the more if we include the subgenera *Pulsatilla* and *Hepatica*. In *Anemone nemorosa*, for instance, the cotyledons are underground, and the first leaf is three-lobed; in *A. blanda* the petioles of the cotyledons are connate so as to form a long tube above ground, as also in *A. narcissiflora*. On the other hand the cotyledons of *A. fulgens* are above ground and normally with separated petioles, while some specimens differed by the partly, or in some cases even completely, connate petioles, as in *A. blanda*. In these species the plumule was kept under-ground, and it is now interesting to see, that in *Hepatica triloba* the plumule is above-ground, the cotyledons free, but here the first developed leaf is scale-like so as to protect the plumule in the first year. In some instances this scale-like leaf was replaced by a small three-lobed or reniform one. *Hepatica angulosa* germinates in the same manner as *Hepatica triloba*, while *Pulsatilla vulgaris* and *P. pratensis* differ from the other ones by having the plumule above ground with the first developed leaves of normal shape. The author describes also the germination of some species of *Dentaria*, which show similar differences.

That the shape of the leaves may depend on certain external causes is shown by *Oxalis rubella* and *Asarum*. In Oxalis the first leaf after the cotydedons is quinate, while the following is fleshy and scale-like; but when the first leaf is cut off the succeeding one attains its quinate shape instead of being scale-like. Asarum develops some scale-like leaves immediately after the cotyledons, and the author shows that by cutting off the blades of the cotyledons, some specimens of Asarum developed two small nearly normal leaves instead of the scale-like ones.—THEO. HOLM.

BRIEFER ARTICLES.

The identity of Asclepias stenophylla and Acerates auriculata.— The Synoptical Flora pertinently suggests the close relationship of these two supposed species. Under Acerates auriculata it is even stated that "unless the characters [i. e. of the two genera] are noted, it is very likely to be confounded with Asclepias stenophylla." Even so; for the two plants look to the naked eye exactly alike.

There was, in Mr. M. A. Carleton's collection of last season in Indian Territory, a plant, no. 248, which is a good Asclepias stenophylla, having all the characters of Dr. Gray's subgenus NOTHACERATES. The hoods, however, on comparison with those from herbarium specimens, were found to be longer, more compressed and more deeply notched on the back than usual, and the asclepiadaceous horn, reaching only a little above the sinus of the hood, was not at once found. This and the cautions in the Synoptical Flora led me to examine closely into the structure of anthers and hoods of all the specimens in the National Herbarium standing under the two above names, with the following result.

First, *Asclepias stenophylla* Gray is represented by three correctly named specimens in flower: one from Dorchester, Mo., collected by J. W. Blankinship; the second from Miami Co., Kansas, collected by Dr. J. H. Oyster; the third from Huachuca Mts., S. Arizona, collected by J. G. Lemmon. Mr. Carleton's no. 248 makes the fourth specimen. Nos. 1 and 2 agree with Carleton's plant in the compressed hoods and notched anther wings, but both have longer horns than the Indian Territory plant, while Lemmon's plant has both the notches in the anther wings and the sinus in the back of the hood very slight, and the horn shorter.

Second, *Acerates auriculata* Engelm. is represented by (1) an Arizona plant, Dr. Palmer's no. 604; (2) a plant collected on the Mexican Boundary Survey under Maj. Emory; (3) Wright's no. 552; (4) Wright's no. 1687. Of these, Palmer's plant has the anthers decidedly notched as in Asclepias stenophylla. The crest in the hood is present as in the first species, and reaches nearly to the sinus, but is not surmounted by any horn. In no. 2 there is still a trace of a notch in the anther wing. The crest in the hood is present, reaching over more than half its length. Nos. 3 and 4 have the crest likewise *present*, but the anther wings are merely rounded. They are however fully as wide near the base as near the top, if not wider.

From these observations, and especially when we take into consideration the long acknowledged fact that these two supposed species of

different genera are *exactly* alike in outward appearance, we cannot escape the conclusion that, in fact as in appearance, we have only *one* species. In every case of reputed Acerates auriculata crests have been found. The wings of the anthers too have been found to be, if not "decidedly auriculate," at least "dilated," certainly not "tapering at base." All of which characters bring these specimens under Asclepias, § NOTHACERATES, provided we allow the following modification of this subgenus.

§ 3. NOTHACERATES. *Anther wings more or less widening to the rounded base, which may or may not be notched or auricled; hood sessile, its apex emarginate or more deeply notched, with a narrow, wholly adnate, internal crest which may terminate above the middle of the hood without a horn, or may be more or less prolonged into a proper horn.*

The projection of this horn above the base of the hood-sinus gives the tridentate appearance mentioned in both the description of *Acerates angustifolia* Decaisne, and that of *A. auriculata* Engelm. I quote, the first from DC. Prodr. VIII, 522: "cucullis gynostegio sublongioribus, apice tridentatis"; the second from Bot. Mex. Bound. 160: "cucullis gynostegio globoso sessili brevioribus apice leviter tridentatis." And as for the stated discrepancy of relative length of anther-mass and hoods, and of the notch in the apex of the hoods, I have, in the material examined, observed all degrees of variation.

The different names of this species, with dates, are as follows:

Polyotus angustifolius Nutt., Trans. Am. Phil. Soc., Ser. 2, v. 201, (1837).

Acerates angustifolia Decaisne, DC. Prodr. VIII, 522, (1844).

Acerates auriculata Engelm. Bot. Mex. Bound. 160, (1859).

Asclepias stenophylla Gray, Proc. Am. Acad. XII, 72, (1876).

There is another species named *Asclepias angustifolia* Ell., Sk. 1, 325, (1821). So the specific name of Nuttall and Decaisne is not available. Engelmann's being the next oldest specific name, this species, it appears, should be named **Asclepias auriculata** (Engelm.).

Since writing the above note there has been found in a collection from Nebraska a plant that represents the Acerates side of this species, i. e., with the hoods destitute of horns, but the rudimentary crests present. This is an interesting find, as it makes the two forms practically co-extensive, at least in their northern range.—JOHN M. HOLZINGER, *Department of Agriculture, Washington, D. C.*

Bartram's Oak.—A long interval has elapsed since the Bartram oak was first made known and still its status has not been satisfactorily determined. Some contend that it is a hybrid. As the oak in question has been found at widely separated localities, although limited to a narrow

range extending from New York to North Carolina (and perhaps beyond this), one might suppose that this fact alone would be deemed sufficient to exclude the theory of hybridity in this case.

Within the last thirty years I have had the opportunity of observing it at different localities in Delaware and New Jersey and am now led to the conclusion that it is a variety of *Quercus imbricaria* Michx., of which we have here two forms, one with entire leaves, the other with lobed ones. On a single specimen, an oak growing in the Bartram Gardens on the banks of the Schuylkill at Philadelphia, Michaux founded his *Quercus heterophylla*. After describing it he remarks: "I was at first disposed to consider this tree as a variety of the laurel oak [meaning Quercus imbricaria] to which it bears the greatest affinity; but the leaves of that species are never indented, and not a stock of it exists within a hundred miles of Philadelphia." It is a tribute to the sagacity of this eminent botanist that, with only the lobe-leaved form before him, he had at that time so clearly discerned the affinity of this oak with Quercus imbricaria.

The evidence of this affinity may be seen when we compare (what is here taken to be) the entire-leaved form with the type and the lobe-leaved form of its variety. If further observation should confirm the conclusions here reached, and I believe that it will, it will then be proper to designate this oak by the name:

Quercus imbricaria Michx., var. *heterophylla* (Michx.).

a. ——— entire-leaved form.

b. ——— lobe-leaved form = Quercus heterophylla Michx.

In 1882 I found an oak in Salem Co., New Jersey, with entire leaves. Specimens from this tree were sent to Dr. Britton, who referred it to his *Quercus Rudkini* (Catalogue of New Jersey plants, p. 223). When first discovered I noticed some features characteristic of the Bartram oak to which I was inclined to refer it at the time. Later observations have now convinced me that it is the entire-leaved form of it mentioned above.

After some hesitation these views are presented in the belief that further investigation will confirm the conclusion here reached and decide a long pending question, the status of the Bartram oak.—A. Commons, *Wilmington, Del.*

The spines of Cenchrus tribuloides L.— It is a well known fact, at least to those who have carelessly handled the vile weed, that the wounds caused by the spines of the involucre of Cenchrus tribuloides are unusually painful and long continued. Personal experience in this regard led me to believe that there were some points about these spines that other spines did not possess and with a view to their

determination an investigation of their minute structure was undertaken. Under a low magnification a mature spine presents the appearance represented in fig. 1. Barbs of various sizes and, for the most part, uniform in shape are disposed irregularly over its surface, being more numerous and larger near the point, the tip of which is well supplied with them. The interior tissue of the spine (fig. 3) is made up wholly of very thick-walled cells, the thickening in many cases being of such an extent as to entirely obliterate the cavity. From the base to near the point of the spine throughout this tissue occur air cavities of different lengths but of nearly uniform width (fig. 1, *a*).

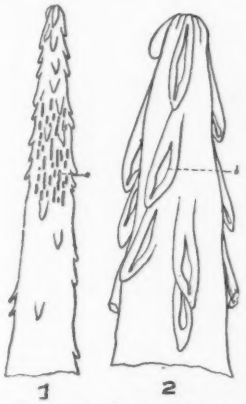


FIG. 1 and 2.—Spines of the fruit of *Cenchrus tribuloides:* 1, somewhat magnified; *a* cavities inside the spine; 2, end of the spine more magnified, *b* cavity of the barb.

When examined under a higher magnification the true nature of the spine makes its appearance (fig. 2). Each barb is seen to have within it a cavity terminating, in the direction of the point, in a narrow tube and to be filled with a substance which in color is light purple. This, in all probability, is of a highly irritating nature and, it may be assumed, is the direct cause of the inflammation of the wound. The barb itself, or at least its point, is of very delicate texture, almost hyaline and is easily broken off; when this occurs the contents of the cavity are free to escape. The cavity seems to have no connection, in the mature barb, with the interior tissue. Neither does there appear to be any means by which the contents of the cavity may be ejected. Consequently they would escape slowly — ooze out — which would account for the prolonged irritation of the wound.—E.E. GAYLE, *Lieut. U.S. A.*

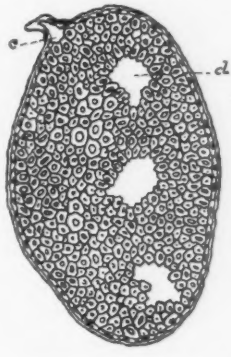


FIG. 3.—Cross section of spine: *c* section of a barb, *d* air cavity.

EDITORIAL.

BOTANISTS ARE a peaceable folk, so peaceable, we are almost inclined to add, as to be apathetic. They seem so averse to anything that has even the semblance of discussion that they will not even express an opinion lest it lead to controversy. If induction is worth anything we can substantiate this by adducing a host of facts on which it is based.

ONE HAS only to look back over the file of the GAZETTE to find that in the past five years there have been suggested numerous questions and movements, some of them of great interest to botanists. These the GAZETTE has presented, sometimes editorially, sometimes through its "Open Letters," and regarding some it has invited and even urged discussion for the guidance of those having the matters in charge. We cannot at this writing recall a single response to these invitations!

NEARLY TWO YEARS AGO the subject of a world's congress of botanists was broached in these pages and we endeavored to find out what our readers thought of the project, its desirability and its feasibility. Several other editorials have appealed for the same information but up to date not a line has come to us touching this matter. The world's congress auxiliary of the Columbian Exposition has now taken it up and proposes to have a botanical congress whether or no. The ideas of the management regarding this particular department are necessarily very general and crude, but it is still quite possible for botanists to direct efforts into proper channels. Will they take enough interest in it to do it? The committee having the preliminary work in charge will shortly issue an address containing a series of questions to which they desire categorical answers. If American botanists have not enough enthusiasm respecting an international congress to express their opinions when asked, we can hardly anticipate that they would have enthusiasm enough to come to such a congress or aid in the entertainment of their guests.

BUT BOTANISTS have a further duty. If they do not approve of the attempt and will not lend both encouragement and assistance, the committee ought to know it in time, so that the American botanists may not be committed to an invitation which they do not extend heartily. Already an announcement has been made by the auxiliary that such a congress is to be held. It remains for the botanists either to direct, it or to let it be known that this invitation if further extended does not come from them, and that it is only a part of the general commercial enterprise. The committee of botanists who have been asked to assist in the arrangements see very many difficulties to be removed before a personal and cordial invitation can be issued. If

proper backing can be secured, moral and financial, they think that a botanical congress can be made highly successful in all respects. The greatest difficulty which they have met so far has been — *your* indifference.

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ANOTHER MATTER of great interest to botanical science is the proposed division of section F of the A. A. A. S. This proposal the GAZETTE opposed when it was made several years ago. We have seen reason to change our minds. Editorially and through the letter of Dr. Halsted, we have endeavored to find out how others regarded the proposition, but we have been unable to extract a single opinion, pro or con. So far as expression of their sentiments is concerned, the botanists might as well be dead!

CURRENT LITERATURE.

A manual of grasses.[1]

The study of the grasses of the United States has long been one of the special functions of the Botanical Division of the Department of Agriculture, and a vast amount of material has been accumulated in the National Herbarium. For many years Dr. George Vasey has been making this great collection of grasses his special care, and his various papers from time to time have testified to his critical study. It has been felt for a number of years that he should put the results of his labors in monograph form, so that botanists in general might share his wide knowledge. In answer to this demand, Volume III of "Contributions from the National Herbarium" opens with the first part of a "Monograph of the Grasses of the United States and British America." The second part, completing the monograph, is promised in a few months. The monograph is in regular manual style, with suitable keys, and a full index which includes synonymy. The author has done a good service to American botany in bringing together our scattered accounts of North American grasses, and the monograph will undoubtedly stimulate the wider study of this very important and very critical group. The Department, as well as the Botanist, is to be congratulated upon the evident desire to cultivate botany for its own sake, and to use some of its money and material in rendering service to the botanical world, as well as to purely agricultural interests.

[1] VASEY, DR. GEO.—Monograph of the Grasses of the United States and British America. Contributions from the U. S. National Herbarium, Vol. III, No. 1, pp. xiv, 89. Issued, Feb. 25, 1892. Government Printing Office, Washington.

Thin wood sections.

The usefulness of well prepared transparent sections of various kinds of woods for numerous instructive and illustrative purposes, is conceded by every one, and by no one more than by the person who has had the privilege of using them. About ten years ago Mr. Henry Brooks, of Boston issued a set of seventeen species of woods, each species represented by three sections, a radial, a tangential and a transverse one, neatly mounted upon cards behind mica slips. Somewhat later a larger set, representing about 200 species of woods, mounted much in the same manner, was prepared by Charles W. Spurr, of Boston, under the direction of Dr. C. S. Sargent, using material from the "Jesup collection" of the Central Park museum, New York. Only a limited number of this set was issued.

There is now in course of publication a third set of wood sections.[1] These are prepared and mounted in a similar manner to those of the preceding sets, except that mica facing is not used, and that a number of minor details are added to increase their usefulness. A new feature of much importance is a well arranged accompanying text.

The author is Mr. Romeyn B. Hough, son of the late Franklin B. Hough, who was for some time U. S. Commissioner of Forestry, and throughout a long life was a student of our native ligneous flora, being the author of a treatise on the "Elements of Forestry," and of numerous other works of a kindred nature. The son has inherited his father's love of the forests, and he has entered into the preparation of the present work with the rich accumulations of information at hand brought together by his father, and with a strong personal enthusiasm.

The work is to be issued in parts of twenty-five species each, each part with a suitable text. The parts will appear as rapidly as they can be prepared, and the whole work is expected to eventually embrace all the most important woods of the United States. Two parts are already issued. The price is five to ten dollars per part according to the style of binding.

The work has a scientific and economic interest, both of which features are admirably met by the accurate naming and preparation of the material and by the extended and important information given in the text. The form in which the work is put up is very ingenious and handy, each part making a volume resembling an ordinary book, although the sections are upon free cards.

[1] Hough, Romeyn B.— The American woods, exhibited by actual specimens and with copious explanatory text. Lowville, N. Y., pub. by the author. 8vo. Pt. I, 1888, pp. vii + 79. figs. 42. 27 cards bearing three wood sections each. Pt. II, 1891.

A large series of lantern slides of wood sections is also prepared by the author, and sold separately. They make particularly beautiful and instructive objects for class use. Untreated wood-section cards of all sizes up to 4½ by 6 inches are also made. They have a fine ivory-like appearance, and may be used for a great variety of useful and decorative purposes.

The Oak.[1]

Looked at as an independent treatise, we have in this book a succinct account of the development, anatomy and economic relations of the English oak, forming a compact little volume that will be useful to every student of forest biology. Space limitations have sometimes necessitated a lack of fulness in statement that tends to obscurity, but in the main the work is good, clearly put, and accurate.

The Modern Science Series, of which this is the third volume, aims, so its editor, Sir John Lubbock, says, "to give on each subject the information which an intelligent layman might wish to possess." We can hardly imagine, however, that any layman, even an intelligent one, would be able to read this book understandingly unless he had had thorough instruction in vegetable anatomy. For example: the account of the course of the fibro-vascular bundles of the stem and their relation to the leaf traces (pp. 43–51) is hard reading even for one who has considerable previous knowledge of this subject both by reading and dissection. This fault, which can be considered a fault only in the light of the editor's preface, runs all through the book.

In these days when University Extension is coming to be such a popular thing we can foresee for this book a useful service. A course of lectures on the life history of plants could be built around it, and the book then be recommended for the supplementary reading which most of such courses require. The simplification and expansion by the lecturer would counterbalance the technicality and conciseness of Mr. Ward, qualities which under such circumstances become desirable. The number of books which can be used in this way is yet very limited and we are glad to recommend this one for this purpose to any who are wondering what they can find for such use.

The illustrations are in the main very good. Some are spoiled by too much reduction (e. g. those on pp. 57, 58, 59, and 111) and some are rather to large for the page, especially those in the chapter on the cultivation of the oak. The make up of the book is very attractive.

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[1] WARD, H. MARSHALL:—The Oak, a popular introduction to forest-botany. Modern Science Series (edited by Sir John Lubbock) vol. III. 12mo. pp. vii + 175. New York: D. Appleton & Co. 1892. $1.00.

Minor Notices.

Mr. H. J. Webber has published an Appendix to the Catalogue of the Flora of Nebraska. The flora of this very interesting state is being vigorously investigated, and as the somewhat arbitrary line between the eastern and western manuals runs through it, such a list as this appendix contains unusually affects their contents. The appendix adds 432 species to the original catalogue, and the recorded Nebraska flora now contains 48 protophytes, 115 zygophytes, 27 oöphytes, 808 carpophytes, 60 bryophytes, 19 pteridophytes, and 1245 phanerogams; in all 2322 species.

The 23d Contribution from the Herbarium of Columbia College is entitled "The American Species of the Genus Anemone and the Genera which have been referred to it," by N. L. Britton. In this paper Dr. Britton reviews the various notions as to generic limitations, and casts in the weight of his authority against consolidation, regarding Anemone and Pulsatilla as worthy of being considered distinct genera. Hepatica and Anemonella are also kept distinct, the latter bearing the older generic name *Syndesmon* Hoffmg. In addition to these genera which are represented from North America, the other American genera, Capethia and Barneoudia, are considered. Pulsatilla, thus revivified, contains two species, the old Anemone patens, var. Nuttalliana, appearing as P. hirsutissima (Pursh). Anemone, thus delimited, is credited with 28 species, 9 of which are confined to South America. Two new species of the United States are *A. Tetonensis* Porter, of Idaho, and *A. Lyallii* Britton, of the northwestern Pacific region.

NOTES AND NEWS.

A preliminary list of the mosses of Lancaster County, Penn., has been published by John K. Small of Lancaster, and enumerates 150 species.

Mr. F. W. Dewart has been appointed general assistant in botany at the Missouri Botanical Garden *vice* Mr. Hitchcock, who has gone to Manhattan, Kans. His duties began March 1.

The February number of Agricultural Science contains two botanical articles: "Notes on the flora of Thunderhead Mountain, Tennessee," by T. H. Kearney, Jr., and "Some recent contributions to mycology," by F. L. Scribner.

President John M. Coulter is lecturing to large University Extension classes in Evansville and New Albany, Indiana, and Louisville, Ky. Each course includes twelve lectures upon the general morphology and physiology of plants.

In addition to continuations of articles already noted, the March number of the *Forstlich-naturwissenschaftliche Zeitschrift* contains the beginning of a paper on the "Influence of living and dead soil covering on the temperature of the soil," by Professor Dr. Ebermayer of Munich.

It is always interesting to follow the track of rare plants, and some articles concerning the proper home of Calypso, were lately published in the Gazette. It seems, however, that it is also quite at home in Europe, as Mr. H. Samzelius happened to find not less than 400 flowering specimens in a birch-forest near Tornio river in the Tornio-Lapmark last June.[1]—T. H.

A committee of prominent botanists has undertaken to remove Stephan Endlicher's body from its unmarked grave in the Matzleinsdorfer Cemetery near Vienna, to the new Central Cemetery, and to provide a suitable monument to the memory of this distinguished botanist and philologist. Contributions may be sent to the k. k. zoologisch-botanische Gesellschaft, Wien 1, Herrengasse 13.

Mr. F. W. Anderson's valuable mycological collections have been donated to Columbia College, New York. He was associated at his death with Dr. and Mrs. N. L. Britton, and his collection being in their care was donated to that institution. His large herbarium of phanerogams is now in the possession of Rev. F. D. Kelsey undergoing revision, and when this is finished it is donated by Rev. Joseph Anderson to Deer Lodge College, Montana, as a memorial of his son.

Alida Olbers has investigated the structure of the pericarp of the Labiatae.[2] The investigation shows that the structure of the pericarp in the Labiatæ is very uniform, although the author has succeeded in finding several differences. These structural differences do not correspond, however, to the systematic position of the genera in which they have been observed; the same group may show different types, while the same type may occur in several and mutually different groups.—T. H.

Dr. M. C. Cooke, the editor of *Grevillea*, announces that with the issue of the next number (June) the twentieth volume and the series will come to an end. His fickle health and increasing years render necessary his withdrawal from the editorship. Whether the journal will be continued in other hands or whether it will come to an end remains an open question. We hope that if it is continued it will cease to be a "species mill" and become an English journal with somewhat the scope and standing of Hedwigia and other cryptogamic periodicals.

The southern tomato blight is treated by Dr. Byron D. Halsted in bulletin No. 19 of the Mississippi Agric. Exper. Station. This is the first time the disease has been critically studied, although it appears to have been known for some time, and to be of considerable commercial importance. Prof. Halsted decides that it is of bacterial

[1] Botaniska Notiser, 1891, p. 174.

[2] Bihang till Kgl. Sv. Vetensk. Akad. Hdlgr., Vol. xvi, part iii, Stockholm, 1891, 20 pp., 2 plates.

nature, and identical with a blight of potatoes. He also inclines to think that it is caused by the same microbe that produces the disease in melons, an account of which was given in the preceding volume of this journal, p. 303.

CROSSING VARIETIES OF CORN has been conducted at the experiment station of Kansas since 1888. The results obtained in 1891 are given in bulletin No. 27, by Prof. W. A. Kellerman. The general conclusions which Prof. Kellerman draws from the whole series of experiments are "that the characters of so-called distinct varieties of corn can, by means of cross-fertilization, be made to blend more or less completely," and that the "blended form, or 'cross,' so far as our experiments indicate, does not generally (if kept free from contamination by foreign pollen), revert perceptibly to the parental types."

MACARONI AS A SOLID MEDIUM upon which to cultivate bacteria is advocated by Prof. G. de Lagerheim, (Centr. f. Bak. u. Par., XI, 147). The sticks are cut into pieces about 4½ cm. long, placed in test tubes, enough water added to cover them, and then boiled about fifteen minutes, or until well swollen and white. The water is now poured off, the tubes closed with cotton plugs, and steam-sterilized in the usual way, when they are ready to use. It is intended to take the place of potato in a measure, as more convenient and satisfactory, and also to add another culture medium for diagnostic purposes, as some bacteria have already been found that will grow upon potato but not upon macaroni.

AT THE REQUEST of Baron Ferd. von Mueller in Melbourne, Baron Otto Nordstedt has undertaken the work of writing a monograph of the Australasian Characeæ, the first part of which has lately been issued by R. Friedländer & Sohn, of Berlin. References are given to preceding papers, which deal with the same subject. Allen's "Characeæ of America" is especially commended for the study of the anatomy and morphology of these plants. Of the ten species, described in the first part, following are new: *Nitella partita*, *N. tumida* and *Chara Leptopitys* A. Br. subsp., *subebracteata*. The paper is accompanied by ten plates illustrating the plants in natural size, accompanied by numerous enlarged details.—T. H.

THE PRESENT SYSTEMATIC arrangement of the phæosporic algæ is not satisfactory. A valuable contribution in regard to the correct understanding of several species heretofore referred to *Adenocystis* has been given by Prof. Kjellmann.[1] He revises the following species: *A.* (*Lessoni* var.?) *Californica* Rupr., *A. Lessoni* Harv., *A. Durvillaei*? Herb. Holm. in sched. and *A. Durvillaei* (Bory) et auct. The result of his examination is that these really represent four different genera, belonging to four families namely: *Adenocystis* Hook. fil. et Harv. of the family LAMINARIACEÆ; *Coilodesme* Strömf., by Strömfelt referred to CHORDARIACEÆ; *Corycus* n. gen. of PUNCTARIACEÆ; and finally a yet undescribed genus of the family SCYTOSIPHONACEÆ.—T. H.

[1] KJELLMANN, F. R.: Undersökning af naagra till slægtet Adenocystis Hook. fil. et Harv. hænförda alger. (A study of some Algæ, which have been referred to Adenocystis by Hooker fil. and Harvey.) Bihang till Kgl. Sv. Vetensk. Akad. Hdlgr., vol. XV, Part III, Stockholm, 1890.

TWO NEW SPECIES of red mycoderma are described and figured by A. Lasché in *Der Braumeister* for March (v. 278). These belong to the class of plants usually called yeasts, but in reviewing the literature he points out that no true colored yeasts, i. e. spore-producing Saccharomyces, have yet been described. The more interesting of the new species is *Mycoderma Humuli*, found upon the leaves of the hop, Humulus Lupulus. It has the marked characteristic of producing new cells by first forming a promycelium, instead of budding directly. The other species was found by accident in making plate cultures, and so came from the air. It is named *M. rubrum*, and shows some tendency toward the occasional formation of promycelium.

AT THE LAST MEETING of the Chamisso Botanical Club, of Berkeley, Cal., one of the members enumerated ninety-eight species of phanerogamic plants in flower in January. The number, though considered quite large, was not the result of systematic investigation but only those casually noticed in flower about Berkeley and on two excursions to the opposite side of the bay. The limits of the list are within ten miles of San Francisco. It is noteworthy that a large proportion are introduced plants which here find congenial conditions, or species of extensive or nearly world-wide range. Professor Greene called attention to the manner of leaf propagation discovered in *Cardamine Californica*, a method known only in two other Californian plants and in few others elsewhere. Other members read papers of local botanical interest.—W. L. JEPSON.

UNTIL QUITE recently it has been assumed that the growth of the mistletoe was necessarily prejudicial to the tree upon which it grows. With the discovery of "symbiosis," or that arrangement whereby two plants live in intimate association one with the other without injury to either, but perhaps with reciprocal advantage, a different view has been taken, and an apple tree is supposed to be advantageous to the mistletoe growing on it in summer, while in winter the evergreen Viscum supplies the deficiency which the apple experiences by the loss of its leaves. M. Gaston Bonnier has been putting the matter to the proof by estimating comparatively the changes which occur in the composition of the two plants and of the atmosphere during growth. For half the year it is found that the mistletoe assimilates food by its green leaves for the denuded apple tree. We cannot give the details of M. Bonnier's experiments, but it is sufficient to say that they completely bear out the idea of perfect "symbiosis," or mutual adaptation, and that save by mechanical obstruction, the mistletoe does no harm to the tree on which it is growing.— *Gard. Chron.* Jan. 23. How is this conclusion borne out by our common American mistletoe?

PROFESSOR G. DE LAGERHEIM, director of the botanical garden at Quito (Ecuador), announces the discovery of European Uredineæ near Quito.[1] He has observed *Puccinia coronata* upon plants of an Avena, the seeds of which had been introduced from Europe; which is the more interesting since none of the species of Rhamnus, upon which the corresponding æcidium lives, have been found yet in Ecuador.

[1] Botaniska Notiser, Lund 1891, p. 63.

The only explanation of this peculiar fact seems to be that the germinating oats were infected with teleutospores of P. coronata, and that both the æcidium and the uredo-generation were passed. According to Plowright,[2] who succeeded in infecting young plants of wheat with sporidia of *Puccinia graminis*, the æcidium generation may be passed, and Prof. Lagerheim supposes the same to be the fact with P. coronata in Quito. He has also found P. graminis near Quito, where it occurred on some varieties of Avena, although none of the species of Berberis, nor even Mahonia Aquifolium, which usually are bearers of its æcidium generation, exist in Ecuador. He is therefore inclined to explain the occurrence of Puccinia graminis in the same way as that of P. coronata.—T. H.

MM. Dewevre and Bordage propose in the February number of the *Revue général de Botanique* a method of analyzing and recording the movements of plants photographically. Instead of the interrupted observations as in the method used by Darwin and later investigators, they succeed in getting a continuous record. The difference is the difference between the occasional observations with an auxanometer and the record obtained by the registering instruments. The plants to be observed are placed in a dark box whose sides are pierced by apertures for the fronts of two cameras, one vertical and the other horizontal. To the tip of the organ to be studied is affixed a spherule of wax which furnishes the bright point whose movement makes the tracing on the sensitive plates. In case it is desired to avoid the alterations produced by darkness the plant and cameras are similarly arranged, uncovered. The dark background for the bright point is secured by placing opposite the cameras long tubes of proper diameter whose inner surfaces are blackened. In both cases the pot needs to be supported so that it can be lowered as growth occurs. The method is certainly a very ingenious one, and capable of valuable service. For the details and necessary cautions we must refer to the paper itself.

In order that the exhibition of weeds at the World's Columbian Exposition may be large, and representative of all sections of the country, Dr. Byron D. Halsted, of the N. J. Experiment Station, New Brunswick, N. J., (having this feature in charge) asks for specimens of the worst weeds from all states and territories. It is suggested that each botanist or local collector, who may be pleased to assist in the work, secure at least three specimens each of the worst weeds in his state or section. In making the specimens it is important that collectors obtain seeds, seedlings in various stages of development, the root system, the flower and flower cluster, and the seed vessels. It may be necessary, therefore, to secure these various essentials at different times during the coming season. If the weed is a large one stress is laid upon the procuring of specimens while they are small enough so that the whole plant, roots and all, can be mounted, without bending, upon a herbarium sheet of ordinary size, that is, not over a foot in length. Persons who will aid Dr. Halsted should signify their intention, and allotments will then be made according to the locality. It is hoped that each state in the Union may be represented by specimens in this national exhibit of our worst weeds. The collecting must all be done during the present season, and the specimens sent in for mounting, labeling, etc., by December 1st.

[2] The connection of wheat mildew with the barberry æcidium; Records of the Woolhope Transactions, 1887.

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